PROCEEDINGS

INTERNATIONAL FOOD CONFERENCE 2016

"INNOVATION OF FOOD TECHNOLOGY TO IMPROVE FOOD SECURITY AND HEALTH"

Surabaya, 20-21 October 2016

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INNOVATION OF FOOD TECHNOLOGY TO IMPROVE FOOD SECURITY AND HEALTH

October 20 – 21, 2016
Universitas Katolik Widya Mandala Surabaya
Surabaya – Indonesia

Organized by:
Faculty of Agricultural Technology, Widya Mandala Catholic University Surabaya
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Asosiasi Profesi Keamanan Pangan Indonesia (APKEPI)
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Indonesian Society for Lactic Acid Bacteria (ISLAB)

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PREFACE

Honorable and Distinguished Guests, Ladies and Gentlemen,

First of all, I would like to thank God the Almighty Father, for pouring His grace and blessings upon our lives. Especially, on this very special occasion, Thursday, 20th October 2016, we all gather here on the 2nd International Food Conference 2016 with the following theme "Innovation of Food Technology to Improve Food Security and Health". This great scientific event is held by the Faculty of Agricultural Technology, Widya Mandala Catholic University Surabaya (WMCUS), in collaboration with the Indonesian Association of Food Technologist (PATPI) Surabaya Chapter, P3FNI and is also supported by the Indonesian Society for Lactic Acid Bacteria (ISLAB), Pergizi Pangan Indonesia, and Asosiasi Profesi Keamanan Pangan Indonesia (APKEPI).

Therefore please allow me to express my sincerest gratitude and highest appreciation to all aforementioned parties which have actively expressed their strong care, commitment, and enthusiasm in handling various issues related to health promotion and well-being of the society through food consumption. This is, indeed, aligned with the theme of 56th Anniversary of WMCUS, namely "Together with all nation's components, the University is strongly committed to establish a competitive Indonesian Golden Generation".

I believe this scientific meeting will provide a great opportunity for researchers and industry practitioners to disseminate and discuss their latest research innovation and findings in the areas of food technology, health, and food securities. This will result in strategy formulation to overcome problems related to the above fields. I hope this meeting may also expand and strengthen the collaboration between academia and industry practitioners.

Through this important event, food technology may be proven to become one of important contributing factors in promoting the quality of human lives. Ultimately, our nation's competitiveness will be enhanced and Indonesia will be more respected by other nations in the global era. May we continuously strive for excellence in our professional lives to serve the community at large so we may become the sign of God's presence and love.

May God bless us all !

Surabaya, 20th October 2016

Rector

Drs. Kuncoro Foe, G.Dip.Sc., Ph.D.

INTRODUCTION TO THE SEMINAR

Honorable guests, ladies and gentlemen

First of all I would like to welcome you all in this beautiful city of Surabaya, Indonesia. We are delighted to have you here to meet and to share our knowledge, research, and discuss latest trend in the area of food technology and nutrition. The topics of our International Food Conference 2016 is "Innovation in food technology to improve food security and health" and this year is the second edition of the conference after successful first edition in 2011.

As we already aware that the field of Food Technology is growing rapidly and its development is making a great impact on the health and wellbeing of the society. Food technology covers wide range of area starting from the simplest food preservation such as sun drying, post harvest handling to reduce losses, to the advanced nanotechnology for functional food application. Therefore food technology has become one of the most important contributors in human life. Nowadays, food technology are not only intended to fulfill the foods needed for daily consumptions, but has also been an important factor playing role in combating health problems in the world. Research on health problems of the society has been polarized into two groups which are health problems because of malnutrition and health problems due to over nutrition and unbalanced dietary and lifestyle habit.

The aim of this conference is to provide forum for researcher and industries to disseminate their latest research innovation in food technology, health, and food security, create opportunities for researcher to discuss health and food security problems around the world as well as the strategy to manage such problems and also Strengthen the collaboration between universities and industries by designing an event for researcher and industries to gather and discuss opportunities for collaborations.

The participants including invited speakers are coming from different countries such as Australia, Malaysia, Vietnam, Italia, Nigeria, and Indonesia. There are total of 81 papers presented in both oral and poster presentation.

We would like to express our sincere gratitude to all of the invited speakers Ibu Tetty Sihombing from BPOM, Prof Son Radu, Dr. Peter Sopade, Prof. Endang Sutriswati, Prof. Hany Widjaja, Ir. Indah Kuswardani, Prof. Rindit Pambayun, Prof. Achmad Subagio, Prof. Anang Legowo, Dr. Tyas Utami, Dr. Agustin Wardani, Prof. Nuri Andarwulan, Mr. Lino Paravano, Prof Hardinsyah, and Prof. Marsono. We would like to express our gratitude to P3FNI and PATPI Surabaya for the assistance in preparation for this conference.

We would also like to thank our sponsors that made this event possible. Last but not least, I would like to thank all members of organizing committee for their full supports and commitments in preparing this conference. I wish that all of us will have a fruitful discussion and for all of you having a pleasant stay in Surabaya. Thank you.

Warm regards

Ignasius Radix AP Jati
Chair of Organizing Committee IFC 2016

CONTENTS

Effect of Egg Reduction and Xanthan Gum Concentration on the Physicochemical Properties of Reduced Fat Rice Cake

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Abstract

Egg plays an important role as a liquid contributor and forms the volume, texture, flavor, and color of reduced fat rice cake. The high price of eggs can make high production cost of reduced fat rice cake. The reduction of eggs in cake making will reduce the cake production cost. Eggs reduction will affect on the characteristics of reduced fat rice cake, so it's needed another material to improve the characteristic of reduced fat rice cake. One material that can be used is xanthan gum. Xanthan gum can make the distribution of trapped air to be uniform when batter mixing, increase volume and softness of cake. This study used a factorial randomized block design with two factors, namely egg reduction which consisted of four levels, i.e. 20%, 30%, 40%, 50% and xanthan gum concentration which consisted of two levels, i.e. 0.2% and 0.4%. This experiment was replicated four times. Data were analyzed using Analysis of Variance at $\alpha = 5\%$. If the ANOVA showed a significant effect, data were analyzed by Duncan's Multiple Range Test at $\alpha = 5\%$ to determine the level of treatments that gave a significant difference. The results showed that interaction of egg reduction and xanthan gum concentration provided significant effect on moisture content, specific volume and hardness of reduced fat rice cake. Xanthan gum concentration provided significant effect on springiness and egg reduction showed significant effect on cohesiveness of reduced fat rice cake.

Keywords: reduced fat rice cake;egg reduction; xanthan gum; physicochemical properties

Introduction

The development of cardiovascular disease is rapid and approximately 40% of deaths associated with the disease. This leads to increase public awareness of health and need for low-fat foods because of the association between high-fat diet with cardiovascular disease, hypertension and certain cancers, especially colon cancer.

Cake is one of the food products made with materials such as flour, fat, sugar and eggs. Rice cake is made by replacing wheat flour with rice flour. Saputra (2013) reported that rice cake contains high amount of fat (margarine) which approximately 81.8% of the weight of flour and has a fat content of 16.84%. According to Pomeranz and Schellenbenger (1971), fat plays an important role in cake quality, i.e. volume, taste, texture, aroma, colour, shelf life, reduce crumb cake, contribute to the softness and moistness and make the cake easier to swallow.

Reduced fat rice cake is made by substituting whole margarine (fat) with a fat replacer. Fat replacer is a material that can replace some or all of fat in food products that aimed to reduce the fat content and calories in food products, but does not change the taste or texture of the food product (Hui, 2006 and Rudolph *et al*., 1994 in Swanson, 1996). One fat replacer that has been used in the reduced fat rice cake making is steamed red kidney bean. Trisnawati and Sutedja (2014) showed that the replacement

of all margarine can be performed with steamed red kidney beans. The reduced fat rice cake had good volume development, good softness and moistness score close to neutral with a fat content of 5.18%. The use of steamed red kidney beans in fresh crushed form is not practical and will lead to a short shelf life so it is developed into red kidney bean flour. Trisnawati and Sutedja (2014) mentioned that reduced fat rice cake with red kidney bean flour as a fat replacer has a better score for pore uniformity, softness and moistness.

The fat content in reduced fat rice cake can be reduced to less than 3% so that it can be classified as low-fat product. Such efforts can be done by reducing the use of eggs. Eggs are tby weight, the largest materials in the reduced fat rice cake, which is 472.7% of the weight of flour. Stadelman and Cotterill (1990) stated that whole egg contains 10.5 to 11.8% of fat, while the yolk contains 31.8 to 35.5% of fat. According to Arozarena *et al*. (2001), the egg had a role in the formation of cake characteristics, namely volume and texture. Hussain and Al-Oulabi (2009) stated that egg whites or whole eggs play a role in the stable foam formation that is containing a lot of air when mixed with sugar. When stable foam is mixed with flour, the foam will form a batter that contains air and has a function like leavening agent. Egg yolks can contribute to flavour and colour while the lecithin can act as an emulsifier.

Moreover, the price of eggs is quite high, ranging from IDR 22,000.00 up to IDR 25,000.00 per kg of eggs. These prices are determined by the shelf life and availability of egg in the market. Fresh eggs from farms are generally sold at higher price than the old eggs. The availability of eggs and the higher demand will also cause an increase in the price of eggs which leads to the high production cost of rice cake. Reduction of the number of eggs can lower the production cost of rice cake.

The egg reduction in reduced fat rice cake will affect the quality of rice cake. In order to maintain the quality, other ingredient is needed to replace the function of the eggs. The decrease in rice cake quality can be solved with the use of hydrocolloid, one of which is xanthan gum. According to Phillips and Williams (2000), xanthan gum is able to assist uniform distribution of trapping air when mixing cake batter, increase the volume of development and the softness of texture. Gomez (2007) mentioned that the xanthan gum is used at a concentration of 1% by weight of flour in cake making. Ashwini *et al*. (2009) stated, the use of xanthan gum at 0.5% in the eggless cake making can produce the highest batter viscosity compared with other hydrocolloids and the eggless cake have a quality that equal to the control cake.

This study aimed to determine the effect of egg reduction, xanthan gum concentration and their interaction on the physicochemical characteristics of reduced fat rice cake. Physicochemical properties consisted of moisture content, specific volume, and texture which include hardness, springiness and cohesiveness.

Materials and Methods

Materials

Reduced fat rice cake making materials consisted of rice flour, eggs, sugar, Na-CMC (Natrium Carboxymethyl Cellulose), xanthan gum, skim milk powder, baking powder and red kidney beans. The materials were obtained from the local market.

Preparation of red kidney bean flour

300 g of red kidney beans were soaked for 10 hours in 1 : 5 ratio of red kidney beans : water. The

red kidney beans were peeled and steamed for 15 minutes at 85 – 90˚C. Steamed red kidney beans were crushed and dried in a oven at 70°C for 5 hours. Then dried red kidney beans were sieved to 80 mesh size.

Reduced fat rice cake making

The basic formula of reduced fat rice cake was 180 g of white eggs, 65 g of egg yolks, 65 g of sugar, 55 g of rice flour, 2.75 g of baking powder, 2.2 g of Na-CMC, 5.5 g of skim milk powder, 15 g of red kidney bean flour and 30 g of water. Reduction eggs were done by reducing the egg white and egg yolk in accordance with the treatment. i. e. 20%, 30%, 40% and 50%. Xanthan gum is added by 0.2% (0.11 g) and 0.4% (0.22 g).

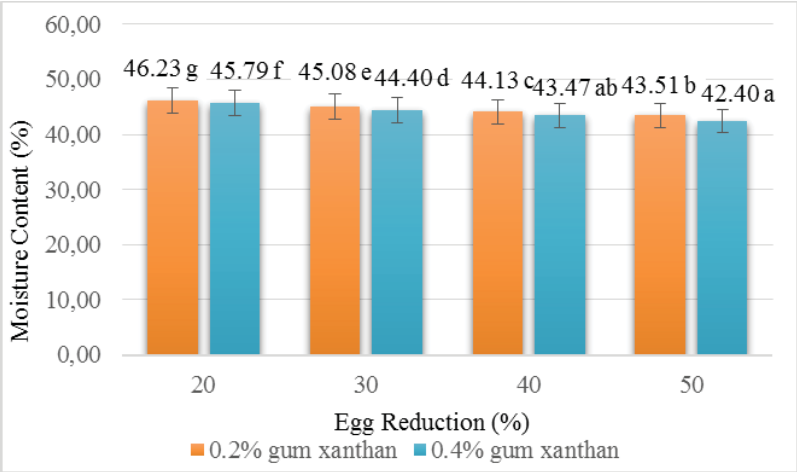
Experimental design and statistical analysis

Experimental design was Completely Randomized Block Design with two factors. The first factor was egg reduction that consisted of four levels, namely 20%, 30%, 40%, and 50%. The second factor was gum xanthan concentration that consisted of two levels, namely 0.2% and 0.4% from rice flour weight. The experiment was conducted with four replications. Data were analyzed using Analysis of Variance at α = 0.05 and Duncan Multiple Range Test at α = 0.05 if there was significant difference between treatments.

Result and discussion

Moisture content

The moisture content of reduced fat rice cake was determined by thermogravimetry method. The moisture content of reduced fat rice cake ranged from 42.40% to 46.23%. ANOVA result at α = 0.05 showed that the interaction of egg reduction and the xanthan gum concentration significantly affect the moisture content of reduced fat rice cake. The relationship between the egg reduction and xanthan gum concentration with a moisture content of reduced fat rice cake and the result of DMRT at α = 0.05 are shown in Figure 1.



Means accompanied by the same letter on the same line do not present a statistically significant difference (α=0.05) according to DMRT's test.

Figure 1. Relationship of Egg Reduction and Xanthan Gum Concentration with Moisture Content of Reduced Fat Rice Cake

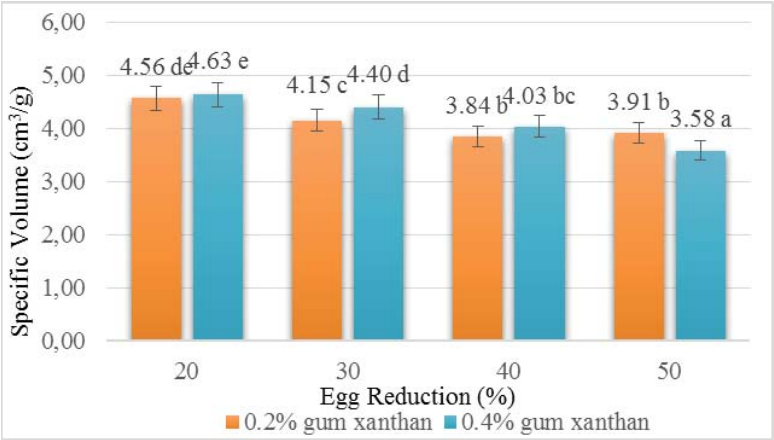
The moisture content decreased at any egg reduction and xanthan gum concentration because of the high moisture content of eggs, especially egg whites. According to the USDA (2010), the moisture content of eggs is 76.15%, so egg reduction leads to reduce water availability in reduced fat cake batter. Eggs also contain proteins that can bind free water in the rice cake batter. The reduced of egg protein caused the water-binding agent in rice cake batter is reduced so that it increased the amount of free water in rice cake batter. Free water was evaporated when baking so that the moisture content of reduced rice cake decreased.

The fat content of egg yolk is 26.54% (USDA, 2010) and lecithin is about 10% (Amendola and Rees, 2003). Lecithin is an emulsifier which acts to form a stable emulsion system in a cake batter. The decrease of fat and lecithin content caused the emulsion system of rice cake become unstable.

Xanthan gum is able to trap water and forms a gel matrix. According Arabshirazi *et al*. (2012), xanthan gum has a structure containing hydrophilic group such as hydroxyl and carboxylate. Miller and Hoseney (1993) also stated that the addition of xanthan gum can improve moisture retention. Increasing concentrations of xanthan gum can help to trap free water and weakly bound water, so the moisture content of reduced fat rice cake getting lower.

Specific volume

The specific volume of reduced fat rice cake was affected by batter volume that formed after mixing. The greater the volume of batter would increase the specific volume of cake. ANOVA results at α = 0.05 indicated that the interaction of egg reduction and xanthan gum concentration significantly affected on specific volume of reduced fat rice cake. The relationship between egg reduction and xanthan gum concentration with specific volume of reduced fat rice cake and the results DMRT at α = 0.05 in Figure 2.



Means accompanied by the same letter on the same line do not present a statistically significant difference (α=0.05) according to DMRT's test.

Figure 2. Relationship of Egg Reduction and Xanthan Gum Concentration with Specific Volume of Reduced Fat Rice Cake

Figure 2 showed the greater egg reduction would decrease specific volume of reduced fat rice cake. The increasing of xanthan gum concentration could increase the specific volume of reduced fat rice cake. Egg reduction resulted in lower egg protein (albumin), fats and emulsifiers. These three components

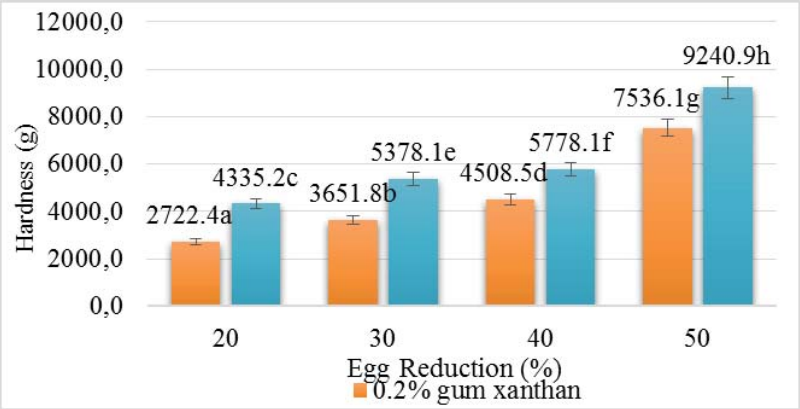
have a function in the formation of foam when mixing. Reduced albumin protein caused less of air trapped in the batter. Egg yolks contain fat that acts to maintain the foam stability. According to Chevallier *et al.* (2000), the fat can form a layer that will provide additional protection to the surface of the foam layer, so that foam will not easily collapse when baking. Egg yolks also contain emulsifiers, namely lecithin. The existence of lecithin is reduced due to egg reduction lead to decrease the foam stability. The decreasing of foam stability caused the trapped air is difficult to be maintained so that the foam collapses easily. All of these decreased the specific volume of reduced fat rice cake.

Xanthan gum is capable to trap free water and weakly bound water in the cake batter. The higher xanthan gum concentration caused more trapped water thus increased the viscosity of rice cake batter. Demirkesen *et al*. (2010) stated that the increasing of xanthan gum concentration affect on batter viscosity. This can increase the stability of the cake batter so that the batter is able to maintain the trapped air. Thus the specific volume of reduced fat rice cake is generally increase at a higher xanthan gum concentration.

Figure 2 also showed that the 50% of egg reduction and 0.4% of xanthan gum concentration resulted in a specific volume of the reduced fat rice cake that is lower than the 0.2% concentration. In this treatment, the egg reduction is very high, so the foam that formed became less. The higher xanthan gum concentration caused the cake batter is too viscous that it can not produce a bigger specific volume of reduce fat rice cake.

Hardness

Hardness value is indicated by the peak value graph (force) after the product is pressed for the first time (Roshental, 1999). The higher the hardness values, means the greater the force applied product against the force exerted so that the product is harder. ANOVA results at $\alpha = 0.05$ indicated that the interaction of egg reduction and the xanthan gum concentration significantly affected on the hardness of reduced fat rice cake. The relationship between the egg reduction and the xanthan gum concentration with hardness of reduced fat rice cake and the results DMRT at $\alpha = 0.05$ in Figure 3.



Means accompanied by the same letter on the same line do not present a statistically significant difference (α=0.05) according to DMRT's test.

Figure 3. Relationship of Egg Reduction and Xanthan Gum Concentration with Hardness of Reduced Fat Rice Cake

Egg whites contain proteins that able to trap air that incorporated when mixing to form a foam

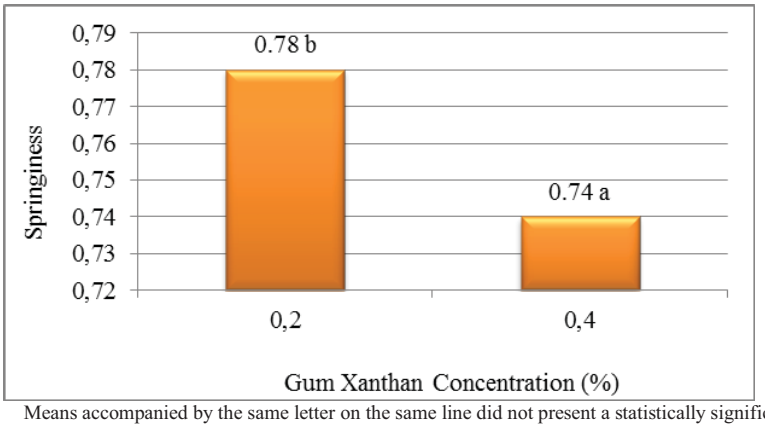
(Charley, 1982). The amount of egg white is sufficient to provide trapping a lot of air. According to Charley (1982), the yolk contains lecithin which acts to form a stable emulsion system in a cake batter. Egg yolks also contain fat components that can help trapping of air by forming a coating on the surface of the foam so that the foam is not easily collapsed and unstable. The optimum condition caused the rice cake batter is able to expand with the optimum so that the pore walls of rice cake are thin, so the reduced fat rice cake has a low hardness.

The egg reduction causes a decrease in the protein components that contribute to air trapping. Fat and emulsifier components contained in the yolk also reduced. The expansion was not optimum that lead the cake's pore wall become thick. This causes an increase in hardness of reduced fat rice cake with the increasing of egg reduction.

The use of xanthan gum leads to reduce free water due to the ability of xanthan gum in water entrapment. This causes the rice cake batter becomes too viscous at the higher xanthan gum concentration. The batter is too viscous resulting in more dense batter and less expands when baking. The pore walls of rice cake are also increasing massively so the cake becomes harder and has the higher hardness values.

Springiness

Springiness is the ability of a food product to return to normal condition after a given pressure (Roshental, 1999). Springiness higher value indicates that the product is more elastic. ANOVA results at $\alpha = 0.05$ showed that the xanthan gum concentration significantly effect on reduced fat rice cake springiness. The relationship between the xanthan gum concentration with springiness of reduced fat rice cake and the results DMRT at $\alpha = 0.05$ in Figure 4.



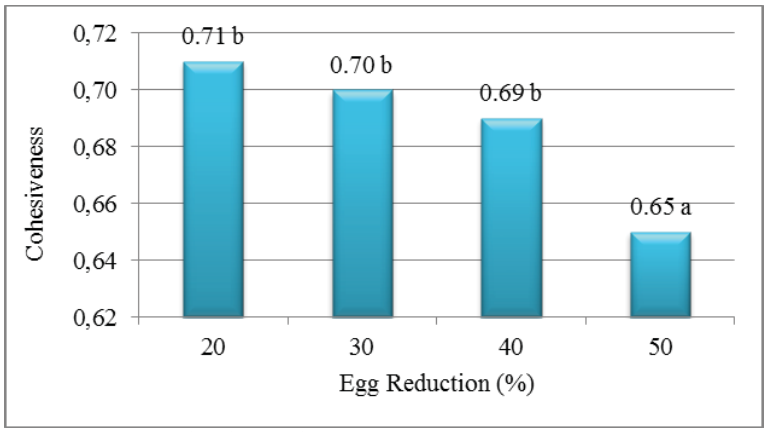
Means accompanied by the same letter on the same line did not present a statistically significant difference (α=0.05) according to DMRT's test.

Figure 4. Relationship of Xanthan Gum Concentration with Springiness of Reduced Fat Rice Cake

Figure 4 showed that increasing the xanthan gum concentration caused decreasing low-reduced fat rice cake's springiness. This is due to the rice cake batter is too viscous, so when baking the structure of reduced fat rice less elastic and less expansion. According to Arabshirazi *et al.* (2012), the addition of xanthan gum can cause the batter structure firmer and reduce the degree of its relaxation. This condition caused the reduced fat rice cake with a higher xanthan gum concentration has a lower ability to return to its original shape after pressured. This is indicated by the lower value of springiness.

Cohesiveness

Moskowitz (1999) stated that cohesiveness is the compactness of each component in a product that will form the texture of the product. ANOVA results at α = 0.05 showed that egg reduction treatment significantly effect on reduced fat rice cake cohesiveness. The relationships of egg reduction with cohesiveness of reduced fat rice cake and results DMRT at α = 0.05 can be seen in Figure 5.



Means accompanied by the same letter on the same line did not present a statistically significant difference (α=0.05) according to DMRT's test.

Figure 5. Relationship of Egg Reduction with Cohesiveness of Reduced Fat Rice Cake

Figure 5 showed that the lower cohesiveness of reduced fat rice cake along with the reduction of eggs concentration. Egg whites have the ability to bind water because of its protein content. Egg reduction caused the decrease of protein content so that rice cake batter become less viscous. Reduced component of egg white proteins also cause a reduction in protein gel matrix that formed so that the structure of reduced fat rice cake becomes less compact. Reduced number of egg yolks also responsible for the reduction in lecithin as an emulsifier and fat components that contribute to the formation of emulsions. This leads to interactions between components in a cake is getting weaker, so cohesiveness values were lower.

Conclusion

The interaction between egg reduction and xanthan gum concentration significantly affect the moisture content, specific volume and hardness. The xanthan gum concentrations significantly affect the springiness, while the egg reductions significantly affect the reduced fat rice cake cohesiveness. The egg reduction as well as the xanthan gum concentration from 20%: 0.2% to 50%: 0.4% resulted in an increase in the value of hardness, but caused a decrease in moisture content and specific volume. Xanthan gum concentration caused a decrease in the value of springiness, while the egg reduction resulted in a decrease of reduced fat rice cake cohesiveness.

The egg reduction and xanthan gum concentration had a significant effect on the texture. Need further study on the effect of the egg reduction and xanthan gum concentration on the sensory characteristics of reduced fat rice cake in order to observe the maximum limit egg reduction and the xanthan gum concentration that appropriate to consumer acceptance.

Acknowledgement

Thanks to Institute for Research and Community Service, Widya Mandala Catholic University Surabaya that has provided research funding through PPPG Research Project 2014.

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Surabaya, 20 October 2016

UNIVERSITAS KATOLIK WIDYA MANDALA SURABAYA
FAKULTAS TEKNOLOGI PERTANIAN

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